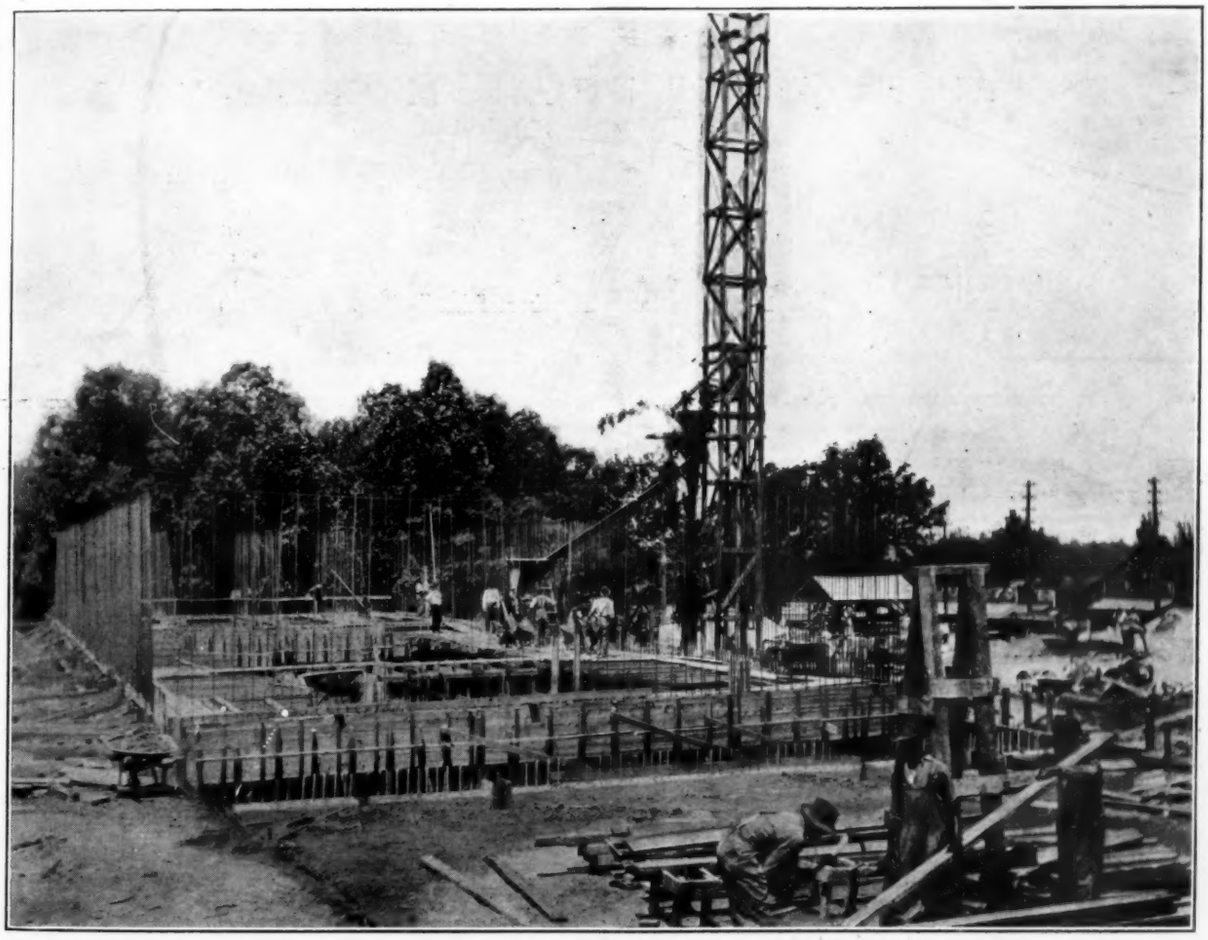
PUBLIC WORKS

CITY COUNTY STATE



GENERAL VIEW OF GASTONIA'S FILTRATION PLANT UNDER CONSTRUCTION

IN THIS ISSUE

SEPTEMBER 24, 1921

PUBLIC WORKS.

CITY COUNTY STATE

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Gastonia's Water Improvements

By W. A. Hardenbergh

Two-million-gallon filter plant, to replace outgrown tub filters, contains some novel features of construction, and the reinforcement is unusually heavy. No corrosive material in filter bottom.

With a population of nearly 25,000 at present, Gastonia, N. C., is one of the fastest growing cities in the south. Within the city limits are some 40 cotton mills, which fact is an index of the city's prosperity. During the past ten years Gastonia's growth has been extraordinarily rapid.

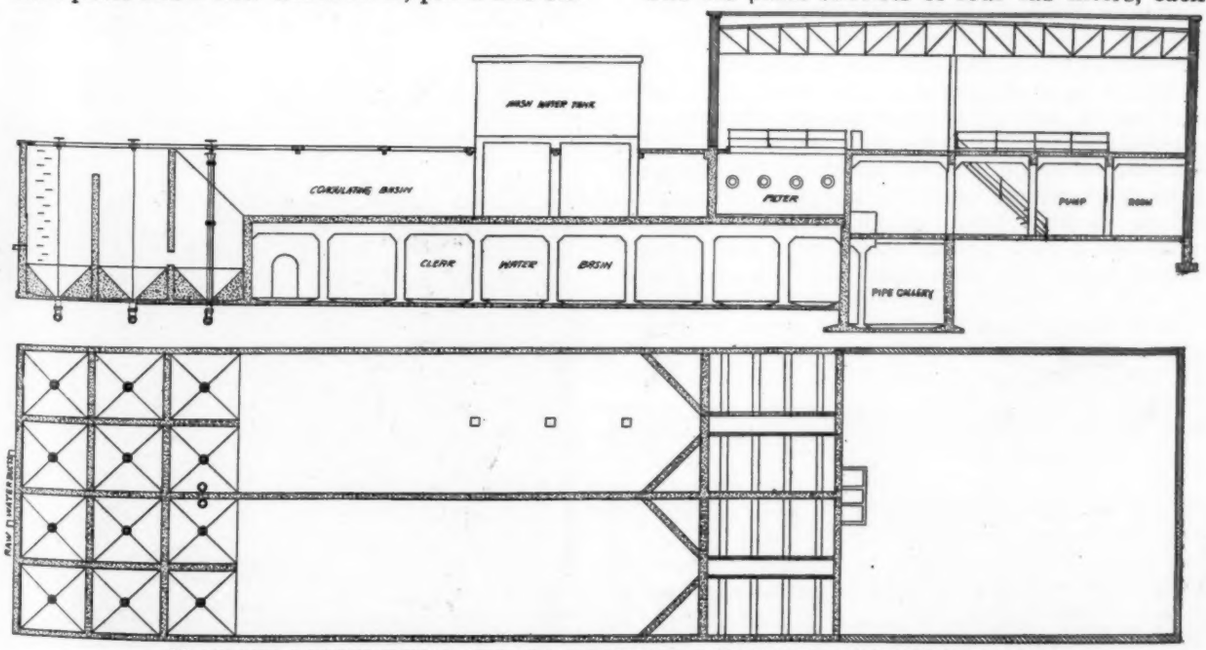
As with many other southern cities, the problems of sewerage and water supply were more or less neglected until the era of high-priced cotton brought to these places a new growth and much money. Gastonia is at present constructing a new sewage treatment plant, but heretofore she has turned her sewage into a convenient stream. Likewise, her water supply, while providing potable water, has been overworked and there has been no reserve for emergencies.

In addition to constructing a new sewage treatment plant and a new water filter, plans and surveys are now under way for nearly a million dollars of street paving.

The water improvements under way call for the erection of a filter house with two filter beds, coagulating and clear water reservoirs, and a high-pressure elevated tank. The total of the contract calls for an expenditure of approximately $110,000. When the new works are completed, the old plant will be used as a stand-by plant. The new filters will have a rated capacity of 2,000,000 gallons per day.

The source of the city water supply is Long Creek, a small stream about two miles north of the city. The water is pumped from this stream into a settling reservoir, from which it is forced through 9,400 feet of 12-inch main by electric pumps to the city filter plant.

The old plant consists of four tub filters, each



PLAN AND LONGITUDINAL SECTION THROUGH GASTONIA'S FILTRATION PLANT

of about 250,000 gallons capacity per 24 hours, tub coagulation basins furnishing a detention period of only 40 minutes and a liquid chlorine apparatus. Aluminum sulfate is used for coagulant. There is no pressure tank, the electric pumps pumping against consumption. When the filters are being washed, pressure in the mains falls rapidly.

The raw water from the 12-inch line leading from the reservoir enters the new plant at the west end of the building, through four inlets. The mixing and settling chambers, where the coagulant will be thoroughly mixed with the raw water, are 35 x 44 feet, and the depth of water will be approximately 24 feet. These primary settling basins have hopper bottoms 11 feet square, with a clean-out in the bottoms connected with a sewer. The sides of the hoppers slope 45 degrees for easy cleaning. Baffles are provided to aid in thorough mixing. The first baffle is standing; the second, hanging.

From the primary settling basins, the water passes into the coagulation basins proper, of which there are two, each 72 feet 3 inches long and 21 feet 6 inches wide. These are placed over the clear water basins. The 12-inch reinforced concrete floor has a slope of 3 inches in order to facilitate cleaning. At rated capacity of operation, the new plant will allow a detention and settling period of 6 hours.

Aluminum sulfate will be applied by dry feed machines, of which two are being installed, one of which will be kept in reserve.

From the coagulating basins, the water will pass to the filters. These are two in number, each 18 feet wide and 20 feet long. Each filter will be equipped with four wash-water troughs. These are of the usual type of elongated "U" of cast iron.

In the design of the filter bottoms, an effort has been made to avoid the use of any material subject to corrosion. The result is a rather unusual type of bottom.

The floor of the filter is composed of concrete, reinforced, and with openings the shape of inverted pyramids, having concave sides. At the bottoms of these inverted pyramids there are set into the concrete quarter-inch glass tubes, such as are used for boiler gauge glasses. The pyramids are 3 inches wide at the base and about 2 inches deep. The filter floor will be covered with an 8-mesh, 20-wire, bronze cloth, and on top of this will be placed the layers of gravel and sand forming the filter proper. The grading and depth of this has not yet been decided upon.

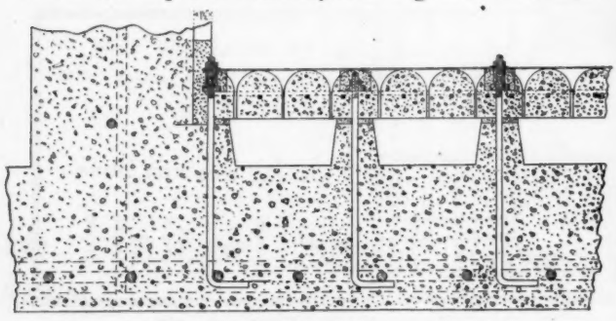
The filter floor is pre-cast of 1:2 cement mortar, in blocks three feet long and a foot wide. The glass tubes are cast in place at the time of casting the blocks. Under the floor proper of the filter is a sub-floor, made up of channels and ridges. The channels are 8 inches wide at the bottom, 4 inches deep, and 9 inches wide at the top. They are set on 12-inch centers, so that the filter floor blocks, which are 12 inches wide and 36 inches long, will just fit on the ridges between the channels. The glass tubes discharge the filtered water into these channels, which convey it into the clear water basins below.

In the ridges iron bolts are cast at 12-inch intervals. These come up between the floor blocks and are used to fasten these down. Carrying out the idea of protection from corrosion, these bolts are covered with cement mortar, which is used to fill the groove in which they are located.

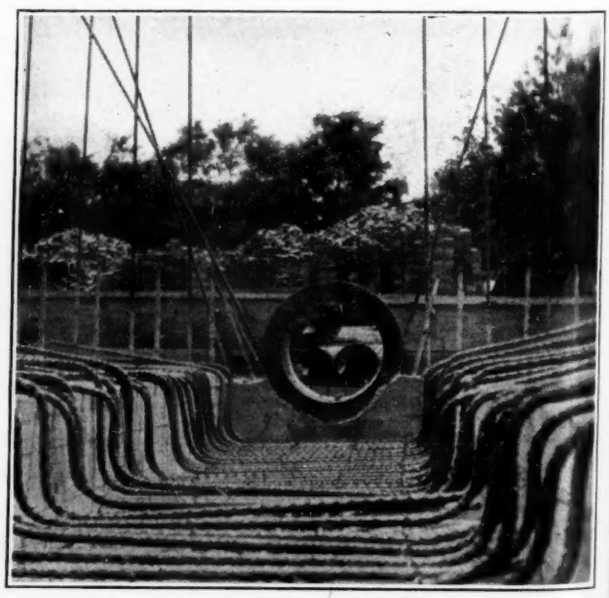
From the filters, the water will pass into the clear-water basins beneath, and from there will be pumped into the mains by direct-connected, electrically driven, centrifugal pumps. Pressure will be maintained by an elevated tank 110 feet high, having a capacity of 305,000 gallons. At present, the construction of this tank is held up because of a suit by a neighboring property owner, who has contended — and his contention has so far been upheld by the courts—that it will be a menace to his life and property, and that it would probably fall upon him.

Water for washing the filters is provided in a tank on top of the filter house, which will yield a large volume of water under low pressure.

The reinforcing throughout the building is very heavy. The walls of the first floor are reinforced with a double row of steel, inside and out. The vertical reinforcing is of ¾-inch square bars set on 6-inch centers, while the horizontal is also ¾-inch bars but set on 12-inch centers. The second



METHOD OF SETTING FLOOR SLABS OF FILTER



REINFORCEMENT OF FILTER TROUGH

floor walls have a single row of reinforcing, ¾-inch bars 6 inches on centers vertical and 12 inches on centers horizontal. The floor over the clear-water basin has a double row, top and bottom, of reinforcing. On the top, ½-inch square bars are spaced 12 inches on centers both ways; on the bottom ¾-inch bars are spaced 8 inches longitudinally and ½-inch square bars 7 inches on centers crosswise.

The concrete in the entire plant is mixed 1:2:4. Broken stone had to be shipped in from Columbia, S. C., but sand was found locally in the beds of small streams. Dominion portland cement was used. Waterproofing was used throughout.

All concrete was mixed with a Rex one-bag mixer. All concrete was placed by barrows. The floors were poured from runways mounted on four-legged horses. The walls were poured from barrows. When a horizontal joint was necessary, as at the end of a day's work, the concrete was "creased" to make a good joint, wetted in the morning, and flushed with a creamy mortar. No placing was done by chutes, but all concrete was delivered to a dumping bucket.

The Rex mixer, while rather small for the job, did excellent work. In one continuous stretch of four days and one hour—forty-one hours of work—70½ cubic yards of concrete were placed.

Excavation for the building was by wheeled scraper and hand. Labor-saving machinery was little used.

The plant was designed by W. M. Piatt, consulting engineer, of Durham, N. C., and F. W. Simons is resident engineer. Tucker & Laxton, of Charlotte, are the contractors, and J. P. Propst superintendent of construction. W. J. Alexander is city manager of Gastonia.

New Dam of Providence Water Works

Actual construction work has been going on for two or three months on a new dam known as the Kent dam for increasing the water supply of Providence, R. I., which will create a reservoir at Scituate. The total cost of this dam will probably approximate $5,000,000. It was planned in 1917 and the plans approved in July of the following year.

In April of this year the water supply board received permission to raise $4,000,000 for financing the construction and bids were opened on April 27. The only bidder under $4,000,000 was Winston & Co., of Kingston, N. Y., whose bid was $3,499,925, and this company received the contract on May 4. Since then a considerable amount of preliminary work has been done. It was found necessary to build a railroad from Jackson to the reservoir for bringing in plant and materials, and in addition the city let a contract to Louis Longhi & Bro., of Torrington, Conn., for $57,464 for building a road around the reservoir 1¾ miles long. The railroad was completed a few weeks ago and machinery and supplies carried over it and steam shovel work begun in July. The first monthly payment for construction work was made on August 15, amounting to $14,994.80.

Rahway's Water Situation

Like many other communities in New Jersey, Rahway is stirred up over the water situation, both the quantity and quality of the public supply being questioned. A committee was appointed to investigate and report upon the subject and many citizens expressed their opinions and various degrees of ignorance of the subject in the daily papers. Fortunately, the chairman of the committee, P. R. Forman, seems to possess a judicial mind too seldom found in the members of citizens' committees of this kind. His report, presented a short time ago, might well be studied carefully by other communities which are confronted by similar problems.

Mr. Forman says that the water can be criticized as to occasional bad tastes and odors and that it is not at all times clear. It is derived from the Rahway river, which passes through a number of communities and cities which contribute sewage and street washings to it, and this pollution, and especially that contributed by chemical plants and other works, is likely to increase. It is to be considered, however, that the supply will apparently be abundant for some years to come, that with such purification as it is now receiving it is safe from a health standpoint, "as has been proven by the health of the community and the best bacteriological tests that we have been able to have made"; the tastes and odors have been traced with reasonable accuracy to a source where the trouble can be removed without insurmountable expense.

If a better supply can be obtained, it then becomes a question as to the cost of this supply and whether the community wishes and is able to spend the necessary money for obtaining the more desirable supply. Rahway is a manufacturing city and makes no effort "to be attractive in appearance and appointments and thereby attract to itself the best class of residents. . . . The majority of its people are employed in various capacities in its factories or in plants in the neighboring communities. The result is that they have not been in a position, from a financial standpoint, to do those things that must be done if a city is to be one that will attract to itself the best class of residents. Therefore, our water calculations must be based on three very important factors:

1. It must be safe for the health of those using it.
2. It must be suitable for manufacturing purposes.
3. It must be within the spending ability of our taxpayers."

Mr. Forman adds that, in view of the fact that the present supply is safe, time can be taken for continuing investigations without the necessity for hurried decisions that may later prove to have been unwise.

In too many instances decisions on improvements of this kind result from hurried action following hysterical propaganda by certain citizens, but it is to be hoped that Rahway will take the advice condensed in the above statement and make a thorough study of the various phases of the problem before taking definite action.

Wisconsin State Highway Department Equipment

According to the Wisconsin State Department of Engineering report for the quarter ending July 1, 1921, the principal items of equipment of the Highway Division received since March 1, 1921, included fifty-two 3-ton Riker used trucks and two car loads of Riker spare parts. These parts are of very good selection and will be of great aid in placing the 52 Riker trucks in condition.

To date there have been received 36 used ten-ton Holt tractors, 30 of which are at work.

Thirty-three Anderson 3-ton, 4-wheel reversible trailers, equipped with 36 x 5 solid tires, have been received. A third allotment of T. N. T. amounting to 227,960 pounds, has been received. This was cartridged by the M. J. Connolly Company at five cents per pound; 156,125 pounds was reshipped upon its arrival to counties and contractors, the remaining 71,835 pounds is in storage at Arcadia.

The following is a list of the miscellaneous material received: 12,770 feet of suction and discharge hose, 2 inch; 12 log wagons; 10 gravel screens; 20 thirty-five H. P. four cylinder motors; 8 fifty H. P. four cylinder motors; 18 truck governors; 3 Buda track drills; 1 machine lathe; 76 crowbars; 68,000 No. 8 detonators; 6 log wagons; 68 rip saws; 5,400 round point D handle shovels; 393 square point D handle shovels; 455 long handled square point shovels; 500 spades; 2 car loads wire mesh, 78 inches wide, in rolls of 150 feet each, eleven gauge wire; 1 Ingersoll-Rand vacuum pump; 1 large air compressor with motor attached; 1 car load pipe fittings and electric motors. (In this car were ten motors ranging from 15 to 50 H. P.

To date there have been received from the Federal Government 545 trucks and cars. Twenty-six of these have been salvaged on account of their unserviceableness. Twenty-six five-ton Pierce Arrow trucks have been transferred to the State of Utah on account of the five-ton trucks being too heavy for service in Wisconsin. The 52 Riker trucks are being held and will not be placed in service this year. This is due to lack of shop facilities. An additional assignment of trucks is now before the counties who are taking a number of trucks. There are still 48 trucks that have not been completely overhauled. It is estimated that these trucks are fifty per cent overhauled.

The trucks in the State fleet have been moving rapidly of late both to counties and to contractors. The Madison shop is now assembling Fords for spare stock. It is calculated to assemble Fords cheaper than they can be purchased, as a number of parts have been received from the government, and on the parts that are purchased a 25 per cent discount is secured.

State Highway Construction Overhead

According to a statement of George Coleman, state highway commissioner, Norfolk, Va., the overhead expense of the Virginia Highway Department, including both engineering and administration costs, averages from 6½ to 6¾ per cent of the cost of construction, as compared to the percentages of 6¼ in Delaware and South Carolina, while that in North Carolina, owing to the recent reorganization preparatory to doing fifty million dollars' worth of work is at present about 10 per cent. In Pennsylvania it is about 9 per cent and in California 15.86. In the Federal Aid projects the percentage runs from 2 to 10 with an average of less than 4 per cent. The high amounts are largely due to conditions where heavy grading is required. In Virginia concrete and bituminous macadam roads in several counties, each of them costing from $100,000 to $300,000 each, have been constructed with a cost of overhead and engineering as low as 3 per cent.

Ideal Section of Lincoln Highway

That section of the Lincoln highway between Dyer and Schererville, Lake county, Ind., has been tentatively selected by the board of directors of the Lincoln Highway Association as the location for the ideal section to form an object lesson embodying the most advanced, modern highway specifications. Extensive investigations of the topography, drainage, soil conditions, costs and other engineering features have been made, and there is rapidly being completed a tentative plan for a development that is expected to surpass all existing rural highways in adequacy, permanency, and beauty. Specifications provide for a concrete pavement 40 feet wide and 10 inches thick with 5-foot shoulders, in the center of a 100-foot right of way. Drainage will be provided by underground tiles, and there will be no open ditches. The 25-foot right of way on each side of the roadway will be improved by a walk for pedestrians on one side. Lights will be provided for illumination at night and a prominent landscape architect is developing a plan to emphasize and improve the natural beauties of the terrain. It is hoped that the grading may be done this year and the paving in the spring of 1922.

Street Pavements in Pennsylvania

The 33 third-class cities of Pennsylvania contain 783.13 miles of paved highways, according to statistics obtained in connection with a survey made by the Bureau of Municipalities of the Pennsylvania Department of Internal Affairs. The largest mileage in any one city is 98.68 in Erie and the next largest is 84.31 in Harrisburg. Next in order is Altoona with 55.66 miles, followed by Wilkes-Barre with 52.88. The least mileage is 2.07 miles in Coatesville, closely approximated by Lock Haven with 2.18 miles.

In the kind of pavement used, brick leads, being the principal pavement used in Bradford, Carbondale, Connellsville, Corry, DuBois, Easton, Franklin, Lancaster, Lock Haven, McKeesport, Meadville, Monongahela, Newcastle, Oil City, Pittston, Uniontown and Williamsport, and one of the two or three principal kinds in Altoona, Hazelton, Johnstown, Reading and Titusville. Asphalt is the principal pavement used in Allentown, Erie, Harrisburg, Wilkes-Barre and York and one of the principal kinds in Altoona, Johnstown, Reading and Titusville. Amiesite is the principal pavement in Bethlehem and Coatesville, and one of the principal kinds in Hazelton. Bitulithic is one of

the principal kinds in Altoona, filbertine in Chester, and wood block in Lebanon, Pottsville and Sharon.

Three of the cities, Erie, Harrisburg and Reading own asphalt repair plants.

All of the cities require the street car companies to pay a part of the paving costs on streets where their tracks are laid. In some cities the companies must pay for the pavement between tracks and for two feet outside the rails, while in others the space outside the rails is confined to nine inches on each side. The majority of the cities use the foot front rule in making assessments of cost of pavement.

Pavement Breaker for Street Trenching

Automatic gasoline driven machine with capacity for breaking 500 linear feet of 8-inch concrete pavement, or frozen clay 18 inches thick, and 6 feet wide, in one 8-hour day.

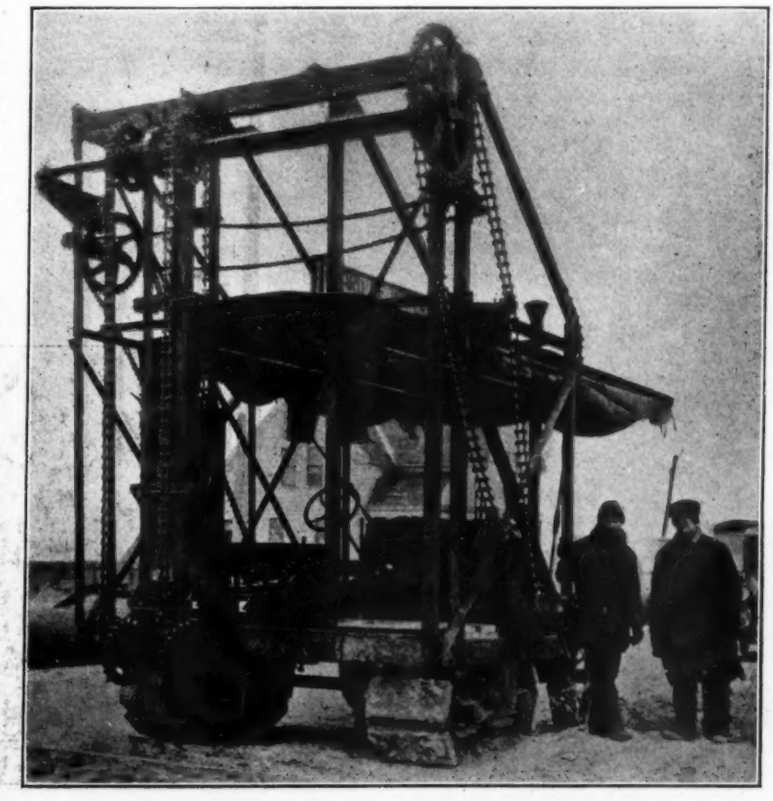
Cutting through the hard surface of streets and pavements to permit the excavation of trenches has been facilitated in Detroit by the construction and operation of two locomotive pavement breaking machines, designed for the Board of Water Commissioners, George H. Fenkell, superintendent, and largely designed by Henry Cousino, engineer of power machinery.

The 9 x 15-foot machine, 14 feet high, weighs 14,000 pounds, is mounted on a pair of short forward crawler tractors and two rear wheels. It carries a short structural steel tower over the tractors, with a transverse track across the top of the front face, on which travels the suspended leads of a 1,225-pound drop hammer operated through sprocket chains from a 15 h. p. gasoline engine mounted over the real axle.

The hammer is fitted with a 9 x 14-inch removable hardened steel bit which has a 90-degree beveled cutting endge that may be set transversely or longitudinally. It has a hoisting speed of 76 feet per minute and strikes 14 blows per minute while the transverse motion of 35 feet per minute to a maximum distance of 6 feet, permits a shift of 21 inches between the blows

The hammer is lifted by hoisting chains that engage tilting spurs from the hammer that are tripped and allow the hammer to fall automatically when the spurs strike adjustable stops, which regulate the height of the fall, which is 7 feet maximum. The transverse motion of the hammer is controlled by a friction clutch and the breaking speed is approximately 15 inches per minute. The machine advances and moves from place to place under its own power at a maximum speed of about 1 mile per hour. It is operated by one man and a laborer following, and consumes 1¼ gallons of gasoline and ¼ pint of lubricating oil per hour.

The machine breaks a surface 6 feet wide and 500 feet long through 8-inch concrete in an 8-hour shift and can be operated on any kind of pavement but is more advantageously used for asphalt work in cold weather than in hot weather when the soft asphalt is liable to stick to the hammer. Last winter the two machines were used to break clay frozen to a depth of 18 inches and covered 500 linear feet of 6-foot trench in one 8-hour day. For wider trenches the machine had to make repeated trips.



PAVEMENT BREAKING MACHINE WITH CAPACITY FOR 3,000 SQUARE FEET IN 8 HOURS

Connecticut Taxes Gasoline

On September 1, Connecticut's new law went into effect taxing at 1 cent a gallon gasoline bought within the state for automobile use. Connecticut is a comparatively small state, and it will be possible for tourists to obtain sufficient gasoline in New York, Massachusetts or Rhode Island to carry them through the state and thus avoid the tax, although owners of automobiles residing in the state will with few exceptions find it impracticable to avoid the tax. Whether any large percentage of tourists will take the trouble neces-

sary to save the 1 cent a gallon remains to be seen.

Concerning this tax the "Springfield Republican" says: "As a means of raising increased funds for road construction and maintenance the Connecticut law has obvious advantages. Certainly it is more fair than a flat increase of the registration fee, failing to differentiate between cars of different sizes and costs. As a smaller and lighter car consumes less gasoline per mile and at the same time contributes less to the wear of the roads, a tax upon gasoline consumption has much to recommend it."

Hell Gate Power House Tunnel and Wharf*

Concreting by tremie and in cofferdam formed by river wall and shore retaining wall. Construction of piers.

CONCRETING

The 1:2:4 concrete, of which about 25,000 yards were used for the tunnels and sea walls alone, was mixed in two traveling plants, each of which was installed on a 40 x 40-foot horizontal timber platform, mounted on wheels on a 28-foot gauge track, laid on a framed timber trestle about 450 feet long, parallel to the sea wall on the shore side. A stiff-leg wooden derrick with 65-foot boom was installed on each of two opposite diagonal corners of each platform, and on a third corner there was an elevated storage bin for aggregate. Near the middle of the river side of the platform there was a timber hoisting tower 60 feet high and a 1-yard Ransome concrete mixer, adjacent to which was the cement storage shed and a working platform. Cement, sand and gravel aggregate were received on scows, unloaded and deposited in storage by the derrick boom. The mixed aggregate was delivered from storage bins to the concrete mixer by gravity through the chute and the concrete was hoisted in the tower and spouted to the wall and tunnel through a huge chute made of two 30-foot and one 10-foot sections, suspended from a derrick boom.

Nearly all of the concrete for the sea wall was spouted to the 1-yard hopper of the 12-inch spiral riveted tremie pipe by which it was satisfactorily placed under water. The tremie and the small working platform enclosing the top of its hopper, were suspended from a derrick boom, the lower end of the tremie was placed on the rock bottom and the tremie pipe and hopper were filled with concrete nearly up to the top of the hopper. The tremie, controlled by guy lines, was then slightly raised and shifted longitudinally and transversely, required changes of elevation being indicated by red and green electric light signals, transmitted to the hoisting engine. About 15 yards of concrete were slowly deposited until the forms were filled to a depth of about 5 feet, after which the operations were more rapid until the form was completely filled on the same day that it was commenced.

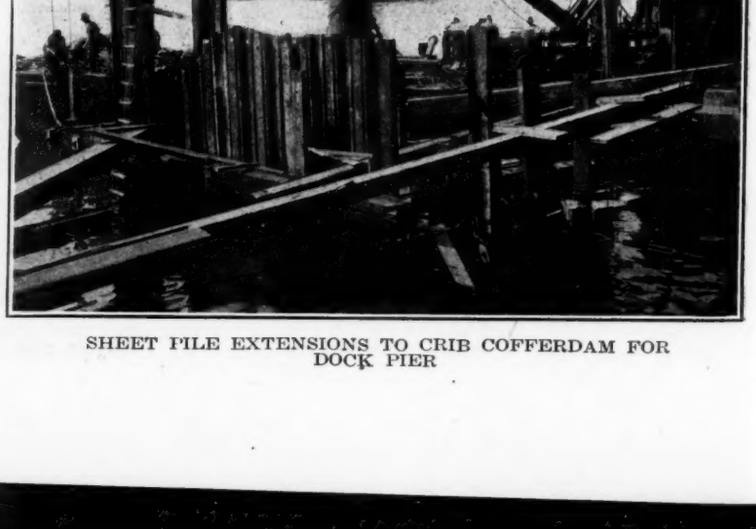
PIER CONSTRUCTION

The river side of the wharf is supported on twelve 6 x 31-foot piers, which were concreted in open removable cofferdams. At the shore end of the piers the foundations for about 12 feet are on approximately horizontal rock surface, 20 feet below low tide elevation. From this surface the river bottom slopes steeply down to a point about 8 feet from the outer ends of the piers, where it is approximately horizontal at a depth of about 35 feet below low tide. At the shore end of the piers the cofferdams are made with detachable wooden panels, but in deeper water Lackawanna steel sheet piles were substituted for the panels to continue the side walls and form the river ends of the cofferdams.

The wooden sides of the cofferdams were full size panels made with solid courses of 6 x 12-inch timber, bolted to vertical outside 12-inch channels. They were assembled together by derrick boats and the panels were bolted together and the bearings on the rock were examined by divers who closed the openings under the cofferdam walls with short 3 x 12-inch vertical sheeting planks spiked on, and sand bags piled up on the exterior in the same manner for the sea wall forms. The derrick boat, securely moored in the proper position, then assembled the sheet piles forming the remainder of the cofferdam, and the lower ends of the sheet piles were banked with sand bags in the same way as for the wooden portion of the structure. The surface of the rock was examined by divers who cleaned it with a hydraulic jet and a centrifugal dredge pump in the same manner as for the sea wall foundation.

The piers requiring about 250 yards of concrete were poured by the tremie method, the concrete spouted from the hoisting tower to the tremie hopper as described for the sea wall.

After the piers had been concreted for 48 hours the bolts in the cofferdams were loosened by div-



SHEET PILE EXTENSIONS TO CRIB COFFERDAM FOR DOCK PIER

*Continued from page 215

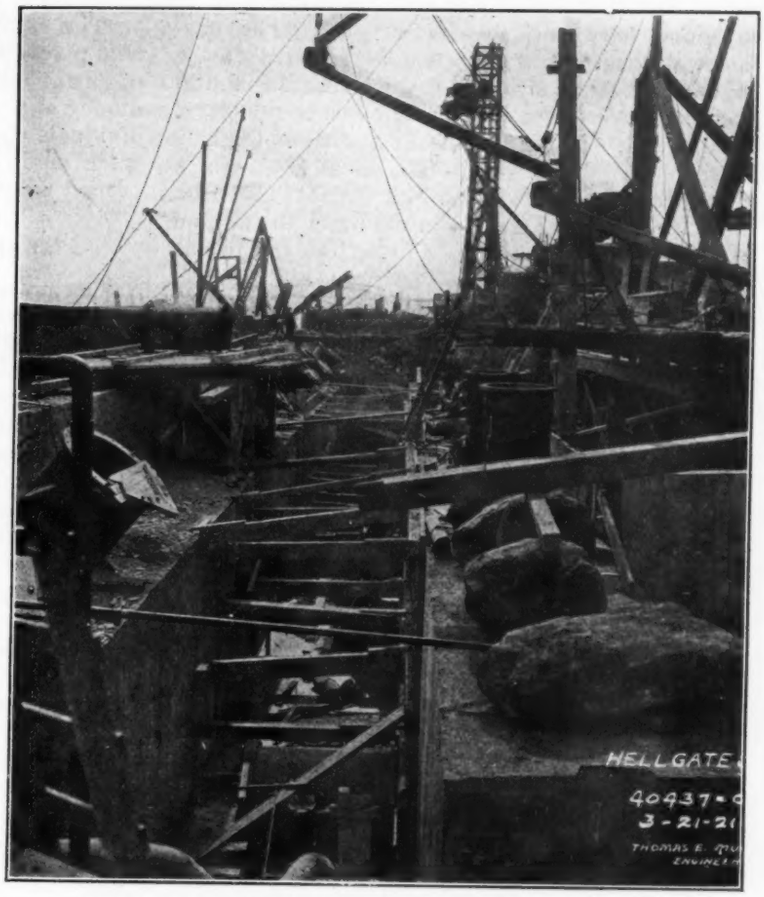
ers, the forms panels were stripped from them, and the sheet piles pulled and both were reassembled for piers in advance.

SETTING THE INTAKE WALLS

Cylindrical holes were cut in the river side panels of the sea wall forms to receive the lower ends of the cast iron intake pipes, 57 inches in diameter outside and 54 inches inside. The pipes were made in three flange connected sections, 7, 10, and 10 feet long from the bottom up, and being heavy, were very carefully placed in position and adjusted by divers before the forms were concreted. The form openings around the lower ends of the pipes were carefully closed with 1-inch boards put on by divers and the concrete around the pipes was lowered in bags and carefully placed by divers until the pipes were imbedded up to low water level.

UNWATERING BEHIND THE SEA WALL

After the completion of the sea wall, heavy wooden bulkheads were installed in vertical recesses provided in it and in the shore retaining wall at the upstream and downstream ends, to enclose the space between it and the shore, and with the wall itself formed a cofferdam which was unwatered by a 12-inch centrifugal pump. The mottom inside the cofferdam was then excavated down



WALLS OF DISCHARGE TUNNEL COMPLETED, FORM BRACING NOT YET REMOVED

SEA WALL SERVING AS COFFERDAM. LOCATION OF DISCHARGE TUNNEL UNWATERED AND TUNNEL FLOOR PARTLY CONCRETED

to sound hard rock by hand work. The surface was cleaned and entirely covered with a mass of concrete from 2 to 6 feet thick, the horizontal upper surface about 10 feet below low tide level forming the floor of the intake tunnels. On this floor wooden forms were built, in each of which there were assembled a pair of vertical cast iron discharge pipes 42 inches in diameter inside and 11 feet apart on centers. These, like the intake pipes, were made in three sections each, flange bolted together and thoroughly braced in position before the concrete was filled in around them, forming sections of the shore wall of the tunnel with intermediate spaces between them. After these sections were stripped, they were connected by form panels on the inner and outer faces and the spaces between them were concreted, completing the inside wall of the tunnel.

The river wall of the tunnel was then completed by concreting up to the battered face of the sea wall and making with the latter a solid mass 16 feet thick that was carried up to the tunnel roof, which is a wide solid reinforced slab 6 feet thick, which was concreted afterwards in a single operation, completing the tunnel and leveling up the top of the wall to the elevation of the wharf floor.

For this work the tremie was, of course, not required, and the concrete mixed on the traveler platforms was hoisted and spouted to position as required. The total amount of concrete in the wharf and tunnel, exclusive of the retaining wall, not here described, was about 20,000 yards.

The work was commenced March 17, 1920, the sea wall was completed January 1, 1921, and the entire concrete structure is now about 75 per cent finished. The present force is about 60 men and the maximum has been about 250 men.

The P. J. Carlin Company is the contractor for the wharf and tunnel, Post & McCord for the steel work and the U. S. Structural Company for the superstructure work. The power station was designed by Thomas E. Murray, Inc., and the entire construction work executed under the immediate supervision of George A. Hughes, civil engineer; John S. Kerins, resident engineer; and John H. Lawrence, engineering manager of that corporation.

Federal Government's Use of Highways

Mercer county, New Jersey, has made a claim on the United States War Department for $198,000, the estimated cost of repairs necessitated by the exceptionally heavy traffic of motor trains carrying war supplies. Burlington county also has claimed $400,000 damages for the same reason. The war department has declined to act favorably on the claims, based on the opinion that "the highways in question have been established and dedicated for the purpose of public use. There can be no question that the United States government is entitled at all times to the free and untrammeled use of public highways to as great an extent as private corporations or individuals."

"The establishment of cantonments and industrial plants was eagerly sought after by most communities by reason of the benefit derived from the money expended by both the government and individuals there employed, so even if extra repairs were made to the roads, the communities concerned were the gainers thereby."

Planning Board for Winston-Salem

The new planning board created for Winston-Salem appears, from local reports, to be possessed of practically nothing but advisory powers, and the benefits which it will be able to confer upon the community will therefore depend largely upon the influence which its personnel may have with the board of aldermen and the weight which its recommendations carry with that board. The planning board is to consist of five members, one being the commissioner of public works, one a member of the board of aldermen and the other three being citizens not identified with the city administration, serving for three years, one term expiring each year, the citizen members being appointed by the board.

The duties of the board are to be the recommendation of plans and maps for new streets, alleys, viaducts, bridges, subways, parkways, parks, playgrounds or any other public improvements; recommendations as to the preservation and care of historical landmarks; and recommendations to public authorities or to any corporation or individual in the city concerning the location of any building, structure, etc., to be erected, and concerning the platting and replatting of land. It will have power to appoint or employ clerical help and to employ such architects and engineers as are necessary to the performance of its functions.

American Public Health Association Semi-Centennial

The American Public Health Association is to hold a semi-centennial celebration in New York City November 8 to 18, which will consist not only of scientific sessions to be held November 14 to 18, but also of a "health institute" during the week previous, a banquet in honor of Dr. Stephen Smith, the founder and first president of the association, who is about to celebrate his hundredth birthday, and the publication of a volume entitled "Fifty Years of Public Health," which will be a history of public health up to the present date. In addition, there will be held in Grand Central Palace on November 14 to 19 a Public Health Exposition (announced as the "first annual") under the joint auspices of this association and the Department of Health of New York City, "to the end that the city and its people may derive the maximum benefits from this very important convention."

Detailed announcements, programs and information will be published later or may be had by addressing the secretary of the association at 370 7th avenue, New York City.

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Starting Up Grade

That a distinct impetus has been given to construction is shown by the fact that a number of the mills in the United States Steel Corporation that have long been closed have been put in operation and many new employees have been taken on in them within the last few days. Such action on the part of the greatest steel interest is sure to be followed by a large proportion of the other steel interests and will have an important psychological effect since it is generally acknowledged that the steel industry is an index of general national activity.

The increase of steel production is a sure sign of increased orders and that in turn means a greater amount of engineering construction to which the larger part of the finished steel products are applied.

Another vital element of engineering construction is Portland cement, which is used in almost every construction job and for few other purposes. According to the last report of the United States Geological Survey the production of cement in July was greater than in June, while the stock on hand was materially reduced from that of the previous month and the total production since January 1 was more than 97 per cent of that in the same period last year. Furthermore one of the greatest cement mills with a capacity of 1,000,000 barrels per year, reports a record production last month, in excess of the annual rate.

Reports from Boston, Pittsburgh, Detroit, Toledo, Chicago, Syracuse and Elmira state that many more workmen are being employed and that the applications for employment are less. In the Pittsburgh district there is a marked increase in freight shipments and it is said that in some quarters there is reason to believe that the lowest point in industrial depression has been passed.

It is probable that for the present there will be little important reduction in the cost of construction materials and as there is now plenty of labor that will be fully employed when industry and construction are under good headway, it is the part of wisdom to make plans for organization and equipment for construction work that may be commenced this season or prepared in advance for next season, or which with special care can be carried on during the winter, thus saving delays, loss from a rising market and greatly diminishing overhead and fixed charges.

Touring Typhoid

For a number of years it has been common for the health officials in most of our cities to expect a greater or less increase in the typhoid rate in the late summer and early fall, such cases having presumably been contracted chiefly by the drinking of impure water at vacation resorts, and being classified as "vacation typhoid." During the past few years the water supplies in the popular resorts of the more progressive states have been pretty well looked after and most of the cases of "vacation typhoid" probably have been caused by impure well water at farm houses and boarding houses which are so numerous that the state health authorities have found it impossible to give them all individual attention.

During the past two or three years the enormous increase in the amount of automobile touring has greatly augmented the danger of typhoid contracted on these pleasure trips. Not only are those touring through the country liable to drink from polluted wells or streams, but, in certain sections of the country especially, a great many of them camp out at points in more or less common use, generally on the outskirts of cities. Since in the majority of cases these camping places are under no supervision whatever, their condition from the point of view of sanitation soon becomes dangerous to campers and there is great probability that many of them may become centers of typhoid dissemination.

The United States Public Health Service is

looking into this matter, paying especial attention to the national parks, endeavoring to make them safe and sanitary for the vast numbers who have recently taken to touring them. On May 15 the service sent its first sanitary engineers into Yellowstone, Mt. Ranier, Yosemite and Grand Canyon parks, while other engineers are being sent to the other parks as they become available. In the largest and most popular parks, such as Yellowstone, it will be necessary for a sanitarian to remain all summer. The work of the health service consists in examining and protecting health supplies, disposing of garbage and sewage, inspecting milk and food and the way they are handled, providing for camp policing and sanitation, and preventing malaria. Malaria carrying mosquitos have been found in Yosemite park and special efforts are being made to eradicate them there and prevent them from obtaining a foothold in other parks.

A number of cities, especially in the west, have provided special camping places near their boundaries where water and sanitary facilities are provided and which are under a more or less continuous supervision. From a health view if from no other, it is desirable that all such camping places be under strict supervision of some state, county or city authority.

The State Highway Department of Pennsylvania has received hundreds of inquiries relative to possible camping sites on the highways of that state and finds that few, if any, municipalities provide such sites. It is reported that there are no suitable locations for camping in the vicinity of Philadelphia, but the automobile club of that city is endeavoring to provide camp grounds on Roosevelt boulevard. On the Lincoln highway there are scores of camp sites along the Juniata river and there are numerous places between Philadelphia and Pittsburgh on this highway where private land owners permit tourists to occupy their grounds. A number of local motor clubs throughout the state have arranged for free camping sites, but so far as can be learned no municipalities of the state have charge of any of these sites, nor does it appear that there are any special precautions taken towards insuring sanitary conditions. Even in the notice sent out by the State Highway Department "it is urged upon all users of sites that they gather up waste paper and other debris upon leaving" but no warning is given of the danger of insanitary practices.

It would seem as though all state health departments should take action in this matter, posting signs at all places used either with or without permission by numbers of touring parties, giving instructions as to where safe water may be obtained, advising the boiling of doubtful water, and giving instructions for sanitary use of the grounds. In addition, they should arrange to in some way secure an enforcement of sanitary regulations relative to the use of camping sites, either directly through their own agents or through the nearest local boards of health. It would seem probable that funds for the payment of at least a considerable part of the cost of this oversight might be obtained by contributions by state or local motor clubs, since it is the motorists themselves who would chiefly be benefited by the enforcement of such sanitary regulations.

New England Water Works Association

Papers and Discussions Before the Fortieth Annual Convention

The fortieth annual convention of the New England Water Works Association was held at Bridgeport, Conn., on September 13 to 16 and was attended by about 150 active members, 100 associates and 160 guests. The program of papers was carried out as printed. The sessions were begun practically on time and, although there was the usual amount of discussion, sufficient time intervened between them to permit of the renewing of old acquaintances or other social gatherings, which is one of the most enjoyable and perhaps profitable features of these conventions.

The exhibit hall was well filled but not crowded with the customary exhibits of meters, brass goods, pipe and other materials entering into the construction and operation of water works plants.

Quite a considerable number of the members brought their wives and daughters with them and the entertainment of the ladies was well taken care of by the committee. The entertainment of the members included an automobile tour of the reservoirs of the city, a visit to the works of the Crane Co. and to the Bridgeport sewage treatment works, where two R. W. screens were in operation; also a picnic and shore dinner at the "Farms." Many of the members spent a large part of their time on the golf links of the Brooklawn Country Club; in fact, the days of the convention being unusually fine, the attendance of only 50 or 60 at most of the sessions was attributed to the presence of many of the members at the golf links.

Following the addresses of welcome and the business meeting on Tuesday afternoon was a description by S. P. Senior, president of the Bridgeport Hydraulic Co., of the water works by which that company supplies Bridgeport with water.

On Wednesday morning the report of the Committee on Standard Specifications for Water Meters, which was printed in the journal of the society for June, was adopted without discussion. Two papers on materials used in water works equipment, "Manganese Bronze for Valve Stems," by William R. Conard and "Monel Metal and Its

Suitability for Water Works Uses," by H. S. Arnold were read and a few questions answered by the authors. As to monel metal, it was stated by Mr. Arnold that monel castings cost about twice as much per pound as bronze, but its greater strength permitted the castings to be made somewhat lighter. It has been adopted for valves in a few cases, but probably more often for metal parts of sewers, sewage plants and other structures subjected to corrosion. It is used for valves for handling chlorine gas.

Following the paper, one of the members asked to be informed what experience others had had with leadite and other lead substitutes and several members responded. Mr. Van Gilder, engineer of the Atlantic City water department, gave numerous experiences with it, as did Mr. Diven. Both had had good success. Some of it at Atlantic City has been in use nineteen years and is still in perfect condition. When leadite joints leak, they are calked with lead wool or a lead "dutchman," Mr. Van Gilder stated, although one of the other members had not had success with this method. The secretary stated that he was arranging to have one session of the winter meeting of the society devoted to a discussion of this question.

On Wednesday afternoon Reeves J. Newsom, water commissioner of Lynn, Mass., read a paper entitled "The Economy of High Initial Cost and Extreme Care in Service Pipe Installation," in which he described the practice in Lynn in laying cement-lined service pipe. He had found that in such services the fittings, which were not lined, filled up with corrosion and recently it had been their practice to line all the fittings with lead. When a cement-lined pipe, carefully cut so as to preserve the square end of the lining, was screwed up against the lead, and the lead was reamed out to full bore if necessary, a practically continuous non-corrosive surface was obtained. Asked how he cleaned services which were stopped up with rust or deposits, he stated that the pipe was cleaned in the usual way but that deposits in the corporations were forced out in the following way: At the end of the service pipe in the cellar a brass ferrule was fastened and a wooden plug fitted into it snugly but not tight. This plug was set in the end of the ferrule and then given a sharp blow with a hammer. This resulted in a water percussion which usually blew the deposit out of the corporation into the main.

Samuel E. Killam, superintendent of the Metropolitan Water Works of Boston, described in a paper how that, during the war, some pipe delivered to the city had been stored in the yard and it was found a short time after that over large patches of the pipe the coal tar lining had entirely disappeared. The attention of the manufacturers was called to it and they stated their inability to offer any explanation. However, they took particular pains with future shipments and the trouble was not repeated. Reference was made to a boat load of pipe being carried to New Bedford which was sunk before reaching the city and later was raised, but by the end of two weeks in the salt water the coating had entirely disappeared. Some years ago the tar coating originally recommended by Angus Smith, and which was presumably the same as that now employed, was tested in salt water by French engineers and at the end of a year was found to be in practically perfect condition. The conclusion was drawn by one or two of the members that the coal tar coating now used was not the equal of that employed fifty years ago. The question being raised as to whether more effective specifications for the tar coating should not be embodied in those for pipe, Mr. Hazen stated that he had furnished to the committee of the society engaged in preparing pipe specifications, the specifications prepared by Professor Dudley for the Pennsylvania Railroad and used by Mr. Hazen, who understood the committee would recommend these specifications. Question having been raised as to the recoating of pipe, Mr. Hazen stated that the Spring Valley Water Co., of San Francisco, recoats its pipe in the yard and that Springfield, Mass., also has provisions in its yard for doing so. Cold dipping or painting appeared to be in general use for recoating pipe, and the fact was brought out that valves are painted by the manufacturers cold, usually with an asphaltum paint, and that this coating seems to last as well as that on the cast iron pipe.

"The Control of Water Waste by House to House Inspection" as practiced by the Bridgeport Hydraulic Co., was described by Gordon Z. Smith, chief inspector. Mr. Smith stated that only 20 per cent of the services in the city, and those the largest ones, were metered and these services paid about 50 per cent of the income. He presented calculations to show that, if metering should reduce the waste to the extent experienced in other cities, it would mean a saving to the Bridgeport company of about $35,000 a year, but that the actual cost of maintaining and reading meters and interest and depreciation on the same would amount to about $60,000, and that the company had therefore decided not to greatly extend the use of meters, for the present at least. This paper was followed by a general discussion on the advisability of using meters, which use was favored by most of the members as being the only fair method as well as being generally to the financial advantage of the company or department. Even though the actual reduction of waste did not amount to more than the cost of metering, it was often the case that enlargement of the supply, and of the pumping and purification plant when these were needed, and also of the distribution system, would be avoided or postponed by the use of meters and that the financial saving here might be very great.

In the evening W. G. Chace, of the Lock Joint Pipe Co., described the latest designs of reinforced concrete pipe as laid by that company, illustrating the paper by moving pictures showing the actual work of construction and of installation.

J. W. Ledoux gave some suggestions on the choice of kind of pipe for water works, stating that under some conditions, while the adoption of cast iron might be conservative, it was sometimes not the most economical and otherwise not de-

sirable. He named some of the advantages of cement-lined pipe and devoted considerable time to the consideration of wood pipe. In discussing the use of wood pipe, some of the members stated that it was not sufficiently tight to make its use desirable where the pressure exceeded 30 or 40 pounds per square inch, and that it would deteriorate rapidly unless kept continually filled with water under pressure.

Following this, William J. Orchard read a paper entitled "The Chlorination of New England Water Supplies," giving a general review of the situation of chlorination in the New England states.

The Thursday morning session opened with a paper by C. W. Marsh, entitled "The Electrolytic Generation of Chlorine at Its Point of Application." He stated that formerly a suitable cell had not been discovered whereby current could be applied to the creation of chlorine economically in the small quantities required by most water works plants; but that he had designed a cell much more efficient than had heretofore been available and in fact that these small cells would produce chlorine at a cost less than that of production by the machines of the large manufacturers. Not only this, but the cost of transportation, containers, etc., was avoided and, still more important, the gas was supplied at atmospheric pressure or slightly less than atmospheric and that therefore there was no danger of escape of the gas from the apparatus. The operation of the apparatus was not at all complicated or difficult nor did it require much attention. The amount of gas did not need to be measured directly but was always directly proportional to the amount of current used, and that by varying the current, the gas could be regulated to the needs of the water being treated. He estimated the cost per ton of chlorine to be $44 for salt, $10 for interest and depreciation, $50 for power (at 2 cents per k. w.), or a total of $104. The labor, he claimed, would be no greater than that required to handle liquid chlorine apparatus and less than that required for hypochlorite. In discussing the paper, Frank W. Green, superintendent of the Little Falls, N. J., filter plant, stated that chlorine manufactured by them for use at the plant cost 1½ cents a pound in addition to the current, which was obtained free by water power at the plant. He stated that four water works plants now manufactured their own chlorine.

The paper entitled "The Typhoid Fever Epidemic at Salem, Ohio," by W. H. Dittoe, was read by Morris Knowles in the absence of Mr. Dittoe. Mr. Knowles had prepared a written discussion of the paper describing the changes that had been made in the Salem plant subsequent to the investigation and following the recommendations of the health board, his firm having been engaged to perform this work. In general it was stated that the epidemic, which was an unusually severe one as to number of cases but with an unusually low fatality rate, was undoubtedly caused by leakage in a gravity line bringing water from wells to the reservoir, which line was paralleled by a sewer supposed to receive only storm water but which was found to receive the house sewage from several residences, one of which had contained a typhoid patient.

Harrison P. Eddy, of the firm of Metcalf & Eddy, read a paper entitled "The Significance of Hydrogen Ion Concentration in Water Purification," in which he endeavored to present in popular language the present knowledge or belief of investigators of this subject and recommended the use of determination of hydrogen ion concentration in regulating the application of chemicals in water purification. This paper was discussed by Frank W. Green and Stephen DeM. Gage.

In the afternoon, S. P. Senior, in place of reading a paper, presented to the society the question: "Can High-Value Watershed Lands Be Put to Profitable Use?"—a question for which his company was endeavoring to find an answer. Quite a number of members expressed opinions and suggestions, although Mr. Senior reminded them that what he specially desired was statements of actual experience. The land referred to was worth $200 or $300 per acre and seemed too valuable to allow it to grow up in weeds or to use it merely for the growing of white pine or other trees. Experiments had been made by his company in growing grass, which required little labor. Potatoes had been raised but at a loss. The company is now raising apple and peach trees on the land. Mr. Diven thought hay would probably be best for the water supply, since plowing the land would be apt to give muddy water after rains. He suggested that alfalfa might give larger returns if the soil was suitable, stating that for hay the soil would probably have to be plowed over at five or six-year intervals, but only about once in ten years for alfalfa.

Mr. Hazen stated that the Spring Valley Water Co., of San Francisco, owned about 100,000 acres of land and had put this in charge of an agricultural department, which drained the land or made other necessary preparations and leased it to farmers on short leases and with restrictions as to what they could do with the land. Some of it was used for crops, some for dairy farming, etc. One of the restrictions was that no land within a given distance of any reservoir could be plowed. Quite a little of it was used for sheep grazing, this being found to be less injurious to the water than cattle grazing. T. L. Bristol, president of the Ansonia Water Co., said that that company had tried raising chestnut trees and white pines, but both of these had been carried off by blight and that they were now trying red pine. The company had tried raising sheep on shares and had lost $3,500 thereby. Alfalfa had been tried but had been winter-killed. They were now growing grass on a considerable part of the area and also cider apples. M. N. Baker recommended Scotch pine from his personal experience. X. H. Goodnough stated that orchards had not been tried in Massachusetts, but that pine growing was quite general and was estimated to yield $7 per acre per year when once established. In raising sheep he believed that the estimate could be used of three sheep per acre. Two or three of the members suggested that if fruit were grown

most of it would be stolen, while others stated that if fruit were grown in quantity, which was the only practicable way, one man could readily guard it during the season when it would be in danger of theft. Rudolph Hering suggested that instead of endeavoring to take over all the land on a watershed and either let it grow wild or be put to some use much less productive than formerly, it might be best to permit the farmers to continue to occupy the land and to guard against ny danger from pollution thereby by filtration and chlorination.

Following this, Allen Hazen discussed in a brief and admirably condensed paper "The Economics of the Several Lines of Defense in the Protection of Water Supplies," these several lines being the removal of possible sources of pollution from the watershed, the taking of precautions where such removal was not possible, the storing, filtration and chlorination of the water. While each of these, if performing its function perfectly and without interruption, might be relied upon to produce a fairly safe water, interruptions of service and specially lapses in efficiency were not only possible but probable and it was the duty of superintendents to adopt all of them to a greater or less extent in order that no practicable safeguard of the health of the people might be omitted. In the discussion several other safeguards called for by special conditions were referred to, such as the preventing of pollution by connecting private and public supplies through factory fire protection installations, special provisions called for by rapid growth of automobile touring, camping, etc.

In the evening a very interesting paper was read by George C. Whipple, in which he gave a comprehensive "Appraisal of the Quality of Water Supplies in Massachusetts," giving both general summaries and tabulated details.

At the last session, on Friday morning, J. Frederick Jackson read a paper on "The Pollution of Streams Affecting Industrial Uses," and Clarence E. Carter and Walter F. Abbott one describing "The Repairs to the Standpipe at Bath, Me.," of which there was little discussion.

Construction Questions Answered

Suggestions as to methods, "wrinkles"and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Drive Small Earth Tunnels

Hardly any kind of construction work is as irregular and uncertain as tunneling may be. It is work that can be easy or difficult, simple or complex, cheap or costly, safe or dangerous, rapid or slow, according to conditions, some of which are uncertain or beyond control and may be unexpected and completely change the character of the work at short notice.

Generally the difficulties of tunneling increase very rapidly with the width and much less rapidly with the length and depth of the excavation. The most important elements are the size of cross section; the character of the material penetrated; and the amount of water and gas encountered. When all conditions are favorable the work may be executed with very simple methods and appliances and when they are unfavorable elaborate and expensive plants may be necessary and great skill and experience and heavy expense be required to do the work.

The conditions and methods of executing the work in rock tunneling are so different from those required in earth tunneling, and as most of the small jobs that may be from time to time encountered by the general contractor are of the latter variety, earth tunnels only will be considered in this discussion. If any of the dimensions of the tunnels are very large, or if it is not known that conditions are favorable or if great accuracy or special requirements are necessary, the work should be done under the direction of competent engineers, by experienced specialists who are provided with the necessary plant and with abundant resources for slow and costly work. Small short tunnels driven through solid dry earth under favorable conditions can be safely executed by comparatively inexperienced reliable workmen and capable superintendents employing well-known methods and appliances and a moderate installation of ordinary equipment.

EXPLORATIONS AND PREPARATIONS

Except for lengths of only a few feet or yards, as where it is necessary to pass through narrow embankments or under streets or roads, and the conditions can be determined by inspection, and where little opportunity is generally possible for choice or for modifications, the first operation should be a careful examination and survey of the site and a subterranean exploration along the alignment to determine as accurately as possible the geological and hydrographic conditions that may be judged to some extent by the topography. Soundings should be taken along the alignment to show the character of the underlying strata and may be made by a sectional steel rod driven with sledges; by sinking small test pits; and by

wash borings made with double pipes driven to the required depth and provided with a water jet that will wash up samples of the soil encountered.

Records of previous local excavations, if there are any, indications observed in nearby railroad cuts, and inspection by a local geologist may often be available for further information of the probable character of the soil. It is especially important to know if the tunnel will be through or below a water-bearing stratum, such as sand or gravel at an elevation below the surface of adjacent streams or lakes or below the level of ground water as indicated by wells in the vicinity.

Large quantities of ground water encountered in the tunnel or shafts are very troublesome and cause great delay, danger and expense.

The soils most easily and safely tunneled are hard, dry earth, clay, dry, coarse, compacted sand, a mixture of clay or sand and gravel or any firm, hard, uniform soil.

The most difficult and dangerous materials are quicksand, silt, soft mud, fine water-bearing sand, sand containing large boulders, sand or earth with pockets of quicksand, gravel or large boulders, or any very wet, soft material, and material containing any obstructions or intersected by seams or fissures containing water. Tunneling where the upper or lower part of the excavation is in earth and the remainder in rock or hardpan is also difficult.

SURFACE SETTLEMENT

Especial difficulty and expense are involved if it is necessary to prevent the surface settlement of adjacent ground, which is always uncertain and almost impossible near the surface in very wet, soft ground. It is generally an important consideration in tunneling under streets or buildings or other foundations. In such cases the tunnel driving itself may be easy and simple, but the displacement and even the drainage of the soil, may cause great danger or damage to adjacent structures. In such cases the tunnels must be driven with great skill and often it is necessary to use methods and precautions that would not be required for the same tunnel driven in remote places, or it may be necessary to safeguard and underpin the adjacent structures before tunneling is commenced.

COMPARATIVE COST OF TRENCHING

The excavation of a certain yardage from the tunnel is always likely to be several times as costly as the excavation of the same amount of material in the open, and it is therefore desirable, other things being equal, to avoid tunneling when there is a choice of other methods, so that often when the final structure is necessarily a tunnel it may be built in the open and afterwards filled in to act as a tunnel.

Generally speaking, sewer pipes, water mains and other conduits can be laid or built cheaper in open trenches than in tunnels where the excavation is in earth and there is plenty of room for handling it and the depth is not greater than 20 or 30 feet. Sometimes, however, it is impossible to open from the surface of the ground as in the case of city streets where traffic must be uninterrupted and tunneling is unavoidable. In very treacherous ground if there are no serious obstructions it is often cheaper and safer to support the sides and roof of a tunnel to maintain the banks of a trench that might be preferable to a tunnel in good soil.

Trench construction is also advantageous in that it can often be prosecuted for long distances or for the entire length simultaneously if necessary, thus permitting the work to be done with great rapidity, and with a correspondingly large force and reduced overhead, while tunnels can often be driven only from one or both portals, or if driven from intermediate points also involve considerable time and expense and equipment for the working shafts, thus adding considerably to the time and cost.

PIPE TUNNELS

Where it is necessary to provide for the installation of sewer, water, gas pipes, culverts and other conduits or small steel culverts and it is not required that they should be accessible for inspection or repairs after installation, a tunnel no larger than the diameter of the pipe may suffice, but if the pipe is only two or three feet in diameter its dimensions are too small for a man to enter it, and work to advantage, and if the tunnel is driven by hand excavation it must be made considerably larger, about 6 x 4 feet being the ordinary, and 4 x 4 feet the extreme minimum of its dimensions. Such tunnels generally require lining or timbering and involve unfavorable excavation of a much larger amount of material than is required for the pipe displacement.

When the length of such tunnels does not exceed 100 or 200 feet they may often be made by forcing the permanent pipe from one end as described in the article on "Installing Pipes Through Railroad Embankments," published October 9, 1920. This method consists substantially of driving the pipe horizontally by powerful jacks operated at the rear end where successive sections of the pipe are added as the forward portion advances. Great care must be taken to preserve the alignment of the pipe and unless the pipe is of very small diameter the progress may be facilitated by some simple mechanical device for excavating at the forward end. If the pipe is two feet or more in diameter it will be possible for a man to enter and remove obstructions at the forward end where the work is very difficult and laborious.

Operations of this sort are likely to be much easier in very soft, wet ground and may be carried on from both ends to the center or even to intermediate shafts although in the latter case it would probably be necessary to operate continually with a single party in one direction only so as to be certain of continuous alignment.

DRIFTING METHODS

Tunnels with a wide cross section are generally constructed by several successive operations, the first being to drive one or more very small tunnels, parallel to the axis of the finished tunnel and within the circumference of its cross section. These advance tunnels are called drifts and from them transverse excavations are made until the entire cross section of the finished tunnel is excavated. Excavation in the drifts which are seldom more than 7 feet high or wide is much

simpler and safer than in large cross sections, although under favorable conditions in good reliable ground the heading of a cross section up to 10 or 12 feet in diameter may be excavated at a single operation; usually, however, under favorable conditions the upper portion will be excavated first and the lower portion, then called a bench, excavated later on.

In ordinary ground the drifts should be high enough and wide enough for two men to work comfortably at the heading, which can be very satisfactorily done with 6 x 6-foot cross sections, dimensions which may be materially reduced if only one man works in it. The advantage of minimum cross section is the smaller amount of material handled and the decreased danger from falling roof. If the ground is treacherous it is very much easier to support the roof for a narrow than for a wide strip and the timbering for a 4-foot width is much lighter, cheaper and easier handled than for an 8-foot width.

For a width of more than 6 feet in bad ground much more complicated excavation and timbering methods are needed. It will generally require the service of experts. If there is reason to anticipate encountering much ground water, it is desirable to drive the tunnel on an upgrade if possible so that it will automatically drain itself, otherwise it will be necessary to provide pumping facilities which may require to be very large in order to keep the tunnel dry enough to work in.

EXCAVATION AND MUCKING

For good clay, hard earth or other satisfactory material a small drift can be excavated with picks, shovels and mattocks, casting the spoil directly into very small dump cars or wheelbarrows or throwing it behind the miners on the floor of the tunnel where it is loaded and removed by the muckers.

Wheelbarrows should only be used for very short distances and should then be provided with plank runways. Otherwise dump cars should be run on industrial tracks. If the tunnel is driven on up-grade the loaded cars can be handled by gravity and the empties pushed back by hand, or in larger drifts may be hauled by mules, which are much superior to horses for this kind of work.

Dump cars may also be hauled by stationary hoisting engines located at the entrance to the tunnel. Engines especially suited for such purposes have been designed to operate with compressed air that is so often available in such circumstances and if not gasoline engines or electric motors may easily be installed. Although the engines are most useful in hauling the loaded cars, it is also easy to anchor a snatch block at the heading and by the use of an endless rope from the drum passed through it, or two separate ropes, to haul the car in both directions by the use of the engine.

TIMBERING

In clay or other good sound earth it is sometimes practicable to excavate two or three feet or even more without artificial support for the roof, but the timbering should be provided in advance and maintained as close as possible to the miners, even though the conditions are apparently not threatening. In good soil it may be sufficient to support the roof with transverse cap timbers across the width of the heading, supported at each end on a vertical post mounted on a longitudinal sill or set on blocks or wedges according to conditions. The caps and vertical posts should have square ends and be cut to uniform length before delivery in the tunnel, and should be carefully wedged to solid bearing. Under specially good conditions they may not cover the whole roof, but generally the entire roof should be supported by them or by longitudinal boards laid close together across the full width to prevent the fall of any loosened material. If any cavities exist above these boards, they should be filled solid with clay or other material as soon as discovered. The caps and posts should be made of a mimimum size of 6 x 6-inch timber, increased to 12 x 12 inches according as the conditions become less favorable. The bents are ordinarily from 2 to 4 feet or at the most 6 feet, apart on centers and under unfavorable conditions may be set close together so as to form a solid mass of timbers.

When the tunnel has a permanent lining, usually of concrete, it may sometimes replace the temporary timbering or, as is often the case, encloses it, retaining the timber after its original purpose has been fulfilled. If the timber is removed it is generally apt to be done piecemeal with great precautions and extreme care to fill the spaces quickly and thoroughly with concrete and prevent any possibility of movement commencing in the earth roof.

In some cases it has been found economical and satisfactory to line a circular tunnel permanently as fast as driven, with segmental wooden blocks, serving at first instead of preliminary timbering, and providing the final lining as well.

Klamath River Power Development

The California-Oregon Power Company plans to construct one or two large dams and develop 94,000 h. p. on a 10-mile length of the Klamath river, Klamath county, Oregon, and has filed application to the Federal Power Commission for permission to construct the work.

$220,972,000 August Building Operations

According to the F. W. Dodge Co.'s review, building contracts awarded during August, 1921, in the 27 northeastern states amounted to $220,972,000, of which $44,797,000 was for public works and utilities. The total volume of contracts let in this territory for the first eight months of this year is 10 per cent greater than the average for the corresponding period in the last five years. The territory reported on is divided into New England, New York state and Northern New Jersey, Middle Atlantic states, Pittsburgh, Central West and Northwest districts, for which the biggest amount reported was in the New York State and Northern New Jersey district where $61,010,000 was reported, an increase of 11 per cent over July. The smallest amount was in the Northwest district, $8,344,000, a decrease of 25 per cent from July.

Recent Legal Decisions

WATER COMPANIES CANNOT BE COMPELLED TO CONTRACT WITH TENANTS WITHOUT POWER TO CUT OFF SUPPLY OF DELINQUENT TENANT SEPARATELY

In a suit by the owner and tenants of several double tenement houses against a water company to restrain it from refusing to supply water to the tenants unless the owner would pay or guarantee to pay the usual charges for water supplied to buildings, the New Jersey Court of Chancery, Millville Improvement Co. v. Millville Water Co., 113 Atl. 516, denied the relief granted for the following reason. In the absence of statutory regulation to the contrary, it is the duty of a water company to lay water mains and all laterals, fixtures and connections in such manner that connections may be made with properties at the boundary lines between streets and alleys and private lots. It is not the duty and privilege of a water company to enter upon private property in the construction of its system beyond that boundary line, and it is not the duty or right of a citizen to lay pipes in the street or beyond the boundary referred to. Accordingly the owners and tenants of a building must accept entire responsibility for the suitable equipment of such buildings to receive reasonable service. Where the equipment of buildings of the class of office buildings or apartment houses makes no provision for the supply of water to the several offices or apartments except by a supply to the entire building as one unit, it is obviously impracticable for the water company to contract with the tenants of the several offices or apartments, unless provision exists to control the supply to each office or apartment. In the premises in question each double building was supplied by one service pipe in such manner that in order to supply one half of either building with water, water must also be supplied to the other half, since no stopcock or shut-off was provided to enable one half of the building to be separately supplied. Should any tenant for any cause determine to discontinue contractual service or seek free service or become delinquent, in order to serve the remaining tenant the water company would be compelled to continue to supply both tenants.

CITY HELD WITHOUT ACTUAL OR CONSTRUCTIVE NOTICE OF DANGEROUS CONDITION OF HIGHWAY FROM OILING

In an action by the owner of an automobile against a city and an oil company, for injuries to the plaintiff's car caused by its skidding into another car on a tar or oil covered highway of the city, it appeared that the oil was put on the road between 3 and 4 o'clock in the afternoon of July 30, 1918, and that the accident occurred between 8 and 9 o'clock of the same evening. The city did not have actual notice of any dangerous condition, and the New York Appellate Division held that the time was too short between the two events to hold it had constructive notice. On appeal by the city from a judgment for the plaintiff, the judgment was reversed and a new trial granted.—Pemberton v. City of Albany, 188 N. Y. Supp. 245.

STATUTORY REQUIREMENT AS TO FREE WATER SUPPLY BY MUNICIPALITY TO CHARITABLE HOSPITAL HELD DISCRIMINATORY

The Ohio Supreme Court holds, Village of Euclid v. Camp Wise Association, 131 N. E. 349, that by reason of the adoption of section 4, article XVIII, of the Constitution, in 1912, municipalities may acquire, construct, own, lease and operate water works free from any restrictions imposed by sections 3963 and 14769, General Code. It is also held that the obligation imposed upon municipalities having water works constructed prior to 1912 to furnish free service to charitable institutions operates as a discrimination against them and in favor of municipalities constructing water works after 1912, and therefore sections 3963 and 14769, General Code, in so far as they require free service to charitable institutions, are in conflict with section 26, article II, of the Constitution of Ohio, requiring laws of a general nature to have uniform operation throughout the state, and therefore inoperative.

DELAY IN PERFORMING AGREEMENT TO IMPROVE PROPERTY WILL NOT WARRANT CANCELLATION

The Ohio Supreme Court holds, City of Cleveland v. Herron, 131 N. E. 489, that where a conveyance of real estate for park and boulevard purposes is made to and accepted by a municipality, the stated consideration whereof was the sum of $3,000, which was paid, and the promise of the municipal authorities to improve said tract in the respects recited in the deed, "all of which shall be done as regards both manner and material pursuant to the direction and discretion of the board of public service . . . as rapidly as possible," and pursuant thereto a large sum of money is thereafter expended, the proposed improvement not being at any time abandoned, the grantor will not be awarded a decree of cancellation and rescission of the conveyance for delay in the prosecution and completion of such improvement, particularly where no ground of forfeiture is stated in the conveyance.

MUNICIPAL WARRANT PRIMA FACIE EVIDENCE OF THE VALIDITY OF THE DEBT

Following City of Sulphur v. State, 62 Okla. 312, the Oklahoma Supreme Court holds, Hamilton Township v. Underwood, 198 Pac. 300, that a municipal warrant is prima facie evidence of the validity of the claim for which it was issued, and if in an action instituted by the owner and holder thereof the municipality asserts as a defense a violation of some constitutional or statutory provision, the burden of proof is upon the municipality to clearly establish by competent evidence that at the time the debt was created for which the warrants were issued, the governing body of the municipality violated the provision of the Constitution or section of the statute relied upon.

NEWS OF THE SOCIETIES

Sept. 26-30 — ILLUMINATING ENGINEERING SOCIETY. Rochester, N. Y. Illuminating Engineering Society, Chicago Section, Chicago with National.

Sept. 26-30 — NATIONAL SAFETY COUNCIL. Boston, Mass.

Sept. 27-30—LEAGUE OF CALIFORNIA MUNICIPALITIES. Annual convention. Santa Monica, Cal.

Sept. 28 (10 Days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Sept. 23-Oct. 9—NATIONAL CONGRESS OF ENGINEERS. Buenos Aires.

Sept. 29-Oct. 1 — PENNSYLVANIA STATE ASSOCIATION OF COUNTY COMMISSIONERS. Annual convention. Harrisburg, Pa. Secretary, L. C. Norris, Clearfield, Pa.

Sept. 29-Oct. 1—AMERICAN ELECTROCHEMICAL SOCIETY. Lake Placid, N. Y.

October—IOWA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION. Seventth annual meeting, Omaha, Neb. Secretary, Jack J. Hinman, Jr., State University, Iowa City, Ia.

Oct. 1-15—LYONS FAIR FOR PROMOTION OF INTERNATIONAL TRADE. Lyons, France.

Oct. 3-7 — AMERICAN ELECTRIC RAILWAY ASSOCIATION. Atlantic City, N. J.

Oct. 5-7 — SOCIETY OF INDUSTRIAL ENGINEERS. National convention. Springfield, Mass.

Oct. 8—BROOKLYN ENGINEERS' CLUB. Dinner. Chamber of Commerce.

Oct. 11-14 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 11-14—AMERICAN ASSOCIATION OF PORT AUTHORITIES. Annual meeting. Seattle, Wash. Secretary, M. P. Fennell, Jr., 57 Common St., Montreal, Canada.

Oct. 12-14 — LEAGUE OF KANSAS MUNICIPALITIES. Annual convention. Lawrence, Kans. Secretary, John G. Stutz, University of Kansas.

Oct. 20-21 — CITY PAVING CONFERENCE. Engineers Club of Philadelphia, 1317 Spruce St., Philadelphia. H. E. Hopkins.

Oct. 20-21—OHIO STATE CONFERENCE ON CITY PLANNING. Annual conference. Columbus, Ohio. Secretary-treasurer — Charlotte Rumbold, Chamber of Commerce Building, Cleveland.

Oct. 24-28 — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, St. Petersburg, Fla.

Oct. 31-Nov. 5 — NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-16—CITY MANAGERS' ASSOCIATION. Annual meeting. Chicago. Secretary, H. G. Otis, city mgr., Clarksburg, W. Va.

Nov. 14-18 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

Nov. 16-18 — NATIONAL MUNICIPAL LEAGUE. Chicago. Secretary, H. W. Dodd, 261 Broadway, New York City.

Nov. 17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Society of Naval Architects and Marine Engineers. New York.

Nov. 17-18—SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. New York.

Dec., 22-23—KANSAS ENGINEERING SOCIETY. Hutchinson, Kan.

INTERNATIONAL ENGINEERS' DINNER

A notable dinner of much professional significance is to be held at the Engineers' Club, New York, October 10th, to formally celebrate the home coming of the mission of distinguished American engineers who went abroad to confer the John Fritz Medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Besides the twelve members of the deputation, which represented the John Fritz Medal Board, there will be present members of the British and French societies by which they were received, together with the library board of the Engineering Societies and the engineers club, the trustees of the United Engineering Society, the officers of the Federated American Engineering, the chairmen of the executive board of the engineering foundation, the American Institute of Mining and Metallurgical Engineers, distinguished members of the four national American engineering societies, representatives of the British Institute of Civil Engineers, Institution of Mechanical Engineers, Institution of Mining Engineers, Institution of Mining and Metallurgy, Iron and Steel Institute, Institution of Electrical Engineers, and the Royal Society of London. France will be represented by the La Societe des Ingenieurs Civils de France.

Invitations have also been extended to Herbert Hoover, Secretary of Commerce, and Charles E. Hughes, Secretary of State, and other eminent American engineers and public men. It is expected that hundreds of civil, mechanical, mining and technical engineers from all parts of the United States will also be present.

Engineers on both sides of the Atlantic are engaged in intensive organization, and it is proposed to establish a new international contact which shall promote concert among the English speaking countries and advance the science of engineering and work along conservative lines for the establishment of international peace.

LOUISIANA ENGINEERING SOCIETY

The first meeting of the fall season was held September 12. Walter Parker presented a paper entitled "The Economic Value of the Industrial Canal."

The following resolution, offered by Mr. Lawes at the June meeting, was taken up for second reading:

Whereas, An ordinance has been passed by the Constitutional Convention and will become a part of the Constitution of the State providing for a State Board of Health to be composed of a President and eight members, five of whom shall be from the medical profession and three from such callings as the Legislature may designate, and,

Whereas, It is becoming more and more generally recognized that the Engineer is, by training and experience, particularly fitted to solve many of the problems, and to direct many of the activities of modern health work, particularly those phases which deal with community sanitation and control of insect-borne diseases, as is evidenced by the fact that the Legislatures of a number of states are requiring the appointment of Engineers as members of such Boards, therefore,

Be it Resolved, By the Louisiana Engineering Society that it heartily favors the appointment of an Engineer, fitted by training and practice to membership on the State Board of Health, and

Be it further Resolved, That the Society gives its unqualified endorsement to having a qualified Engineer appointed as a member of the State Board of Health, and expressly requests the Legislature at its next meeting to provide for such appointment.

PERSONALS

Sinks, Frank F., has opened an office in Seattle, Wash., for the practise of industrial and structural engineering.

Anderson, H. F., has been appointed road engineer of Mecosta county, Mich.

Dr. Miller R. Hutchison was elected president of an organization to investigate and develop inventions with offices in New York City.

Murray & Flood has been recently organized and has offices in New York.

M. M. Wyckoff has organized the Wyckoff Engineering Corp., New York City. They will engage in the general practise of engineering and contracting.

R. W. Downie has been appointed tester of building materials for the Welland Ship Canal with laboratories and office at Merritton, Ont.

Chas. M. Binford has opened an office in Beckley, W. Va. Here he will specialize in examinations and reports of coal lands and reports of coal lands and properties, the design and construction of coal plants, the improvement of existing plants to increase their capacity, town planning and building, suburban development and supervision of construction.

Vaughan-Lloyd, W. E., has been elected by the board of aldermen as director of parks and playgrounds of Winston-Salem, N. C.

Glasgow, L. J., has been re-elected sanitary officer of Winston-Salem, N. C.

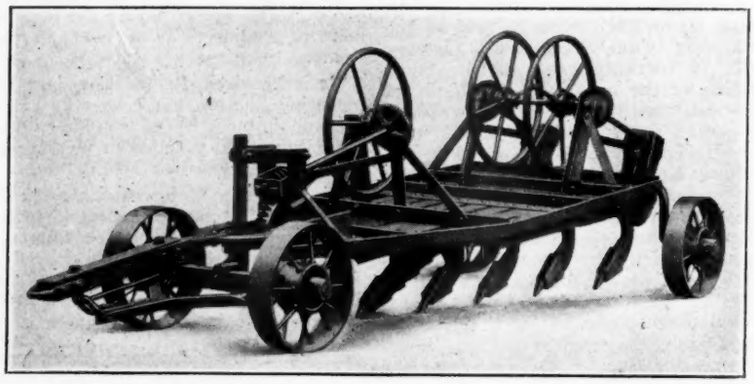
Atherton, Mayor A. of Newark, O., was removed from office September 10th by Goernor Harry L. Davis on charges of gross neglect by the Newark Law and Order League.

Borden, George W., assistant state highway engineer of Nevada, has been named acting state highway engineer to succeed C. C. Cottrell, resigned.

Conner, C. V., formerly with the Delaware state highway department, has been appointedl assistant engineer on th design and general field inspection of bridges and hard surface pavements with the North Carolina Highway Commission.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



SCARIFIER WITH TEETH IN RAISED POSITION

THE KILLIFER SCARIFIER

This machine, manufactured by The Good Roads Machinery Co., has been tested on all kinds of work, is claimed to be economical, convenient and serviceable for tearing up any kind of roadway that can be handled by any type of scarifier. It is designed to overcome the faults of other scarifiers that have a heavy cast iron frame mounted on small wheels, equipped with picks forced into the ground by screws and the weight of the frame and thus subject to disadvantages of great weight to secure penetration making it difficult to handle and requiring great power to pull it either empty or in operation, and making it too expensive for general operation on all classes of work.

The scarifier has a well braced steel frame to which are attached tooth standards and all mounted on a heavy four-wheel truck. The tooth bars are integral with the frame, the front end of which is lowered or raised independently of the rear end. In operation the front is lowered first and as the teeth begin to enter the ground the rear is lowered and the operation is made easy by the size of the hand wheels and the gears used for this purpose. The front is lowered through a toggle arrangement fastened to a worm segment operated in a unit casing preventing the possibility of the parts to get out of line and the rear end, which is similarily handled independently of the front, can be lowered on either side separately.

The front axle is of the rocking type and relieves the frame of twisting strains. The principal connections are riveted and parts subject to heavy strains are steel forgings. The tooth holders are of high carboned steel and the teeth are of the best grade of tool steel, heat treated and hardened.

The machine is furnished with nine teeth all of them removable so that for extremely hard work the usual practice is to operate only five teeth.

When the front end of the machine is lowered and the machine started, the teeth automatically enter the ground and the depth of cut is controlled by the bevel and worm gearing. The long wheel base enables the teeth to enter any kind of ground that is possible to tear up and insures steady running and even cutting because the teeth do not follow the inequalities of the road surface as in some other styles of scarifiers. The machine will stand the strain of a 45-h.p. tractor, but can be used with less power for many classes of work.

The machine has a wheel base of 146 inches, 64-in. tread for rear and 40-in. for front wheels. It has 9 tooth points of 1½-inch square steel and 1½x4-inch carbon steel tooth standards. The approximate weight of the scarifier with 9 teeth is 4,350 pounds.

OSGOOD RUBBER TIRED STEAM SHOVEL

The Osgood Company have just put on the market an 18¾-yard Traction Revolving Steam Shovel equipped with solid rubber tires built and furnished by the Firestone Tire and Rubber Company of Akron, Ohio.

These shovels are especially provided, as are all other Osgood 18 Traction Steam Shovels, with means for disengaging the traveling gears for towing by auto, truck or otherwise and with provisions for attaching the towing attachments or tongue. These features permit them to be towed with all machinery disengaged, thereby requiring only a minimum of pulling power.

For traveling over streets or highways under their own steam all of these size shovels are provided with a two-speed gear arrangement by which is obtained a traveling speed of 3½ miles per hour.

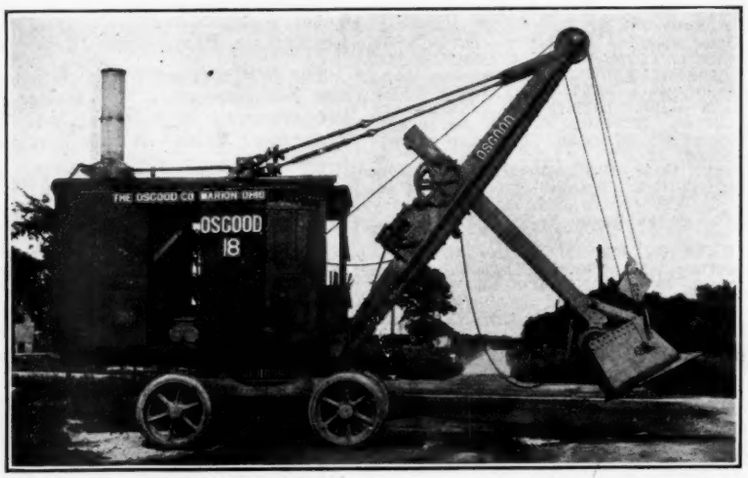
The tires are 40 inches in diameter, by 14 inches wide, ribbed tread, mounted on steel rims. These are pressed on the regular 34-inch diameter by 16-inch face cast steel wheels, which arrangement permits the removal of the tires when desired, and by attaching the cleats to the rear wheels, is then ready for service where it is not desirable to use the rubber tires.

This outfit so designed and mounted eliminates the damaging of thoroughfares, permits movement from one location to another with ease, decreases disturbance and delays along the route, whether towed or moving under its own power, permits them to be moved at an astonishing rate of speed and eliminates the vibration usually experienced when running on steel wheels.

DURABLE SMOKE RESISTING PAINT FOR STEEL

The Du Pont Magazine states that Du Pont Antoxide, a rust-inhibitive paint, is used on the steel flues that carry smoke to the largest smokestack in the world. This stack is 500 feet high and 72 feet wide at the base, with flues leading to it from the smelters of the Anaconda Copper Mining Company of Butte, Montana. On top of the masonry two additional steel flues discharge the smoke and hot gases into the air.

Antoxide has protected these flues for more than fourteen years—and the coating is still in good condition. No other paint tried has stood up under this exceptionally rigid service test longer than twelve months.



TRACTION REVOLVING SHOVEL EQUIPPED WITH RUBBER TIRES